2.0 Summary of RiverPro Operations

This section gives an overview of the method by which RiverPro generates river products. RiverPro creates products using a structured procedure. The basic steps for generating a product are as follows:

1) The input data needed for determining the recommended product generation settings are retrieved. Data are loaded for each forecast point, including stage or discharge data representing the current hydrologic stage of the location, as well as the static data such as the station characteristics data, and "carryover" information maintained from previous executions of RiverPro. Input data are discussed in detail in Appendix D.

2) The recommended product to generate and forecast points to include are determined using the input data and data derived from it. The instructions for generating the product are then loaded based on the recommendations. The method for determining the recommendations is described in Section 3.0.

3) The user then customizes these recommended settings, as desired. This can include changing high-level product settings such as which product to generate, which forecast points to include in the product, or which phrase templates to use. RiverPro templates contain the detailed instructions for creating the product, including the actual phrases to be inserted into the product. Customization of these settings is performed via the RiverPro graphical user interface, which is not covered in this reference manual. However, the settings themselves are described in detail during the explanation of how RiverPro generates products, which is covered in Section 4.0 for official products and in Section 5.0 for NWR/CRS products. The internal storage of the settings information is covered in Appendix C.

4) RiverPro then generates the product using the specified settings and the phrase templates. The templates are described in detail in Section 6.0 and in Appendix A and B.

The user is encouraged to review the recommendations in detail and override the recommended settings as they wish. An overview of each of the above steps is given below.

2.1 Data Retrieval

RiverPro extracts certain data upon initiation; the remainder is accessed on an as-needed basis. The initial data sets read by RiverPro include the following:

- Forecast point names and their groups, where forecast groups are typically defined in accordance with river reaches or river basins and include one or more forecast points.

- For each forecast point, pertinent station information, including the stage or discharge category threshold values, flood stage or discharge, etc.

- For each forecast point, information associated with the previous product in which the forecast point was last included (a.k.a. carryover data). This includes the maximum stage or discharge and its time as of the time of the previous product, and it includes the product category of this previous product.

- For each forecast point, hydrologic state data that includes the latest observed stage or discharge and the maximum forecast stage or discharge for each forecast point.

In the above items, repeated references are made to stage or discharge. For each forecast point, RiverPro will try and extract data for one or the other, based on which element is designated in the database as the primary element for the forecast point. If data are not available for the primary element, it will not attempt to use the other. The concept of type-source ranking is employed when obtaining the value, where RiverPro first tries to retrieve the value for the highest type-source code for the primary element. If it is unavailable, then it tries to retrieve the value for the next highest ranked value and so on.

When determining the maximum forecast value, RiverPro uses instructions for each forecast point that dictate whether it should use the maximum forecast from the latest issued time series of forecast data for this forecast point. This is the normal mode and results in the fastest processing. Alternatively, the instruction can indicate to allow use of previously issued forecast time series if the latest time series issued does not cover part of the time window being considered. This mode is slower, but allows short-term forecasts to be considered, even in the case when there are long-term forecasts that have a more recent issuance time for the forecast time. This “use latest forecast” instruction is defined in the IHFS database as part of the River Station parameters.

These data sets are used to determine recommended settings for the product generation. Most of the dynamic time-series data for forecast points, and all data for

locations that are not forecast points, are retrieved on an as-needed basis when generating the product. The remaining static data are also retrieved as needed.

2.2 Determination of Recommended Product and Forecast Points

RiverPro analyzes the current observed and maximum forecast data values, together with the carryover data, and recommends a product category and a set of forecast points to include in the product. Although RiverPro is capable of generating a product with any specified product category, for purposes of recommending a product, it only considers the following products: RVS, terminating FLS, FLS, and FLW.

The product category recommendation reflects NWS policy, where an RVS is used for non-flood situations, an FLS is used for continued flooding or to terminate flood events, and an FLW is used for initial flooding or additional flooding. An FLS which serves to terminate a flood event is referred to as a terminating FLS.

The recommended forecast points to include are based on which product category is being created, and by making sure that forecast points in a previous warning product are properly terminated, and some other considerations. Although RiverPro is capable of including data in the product for locations other than forecast points, when RiverPro determines which locations to recommend for inclusion, it only considers the forecast points.

2.3 Definition of the Product Content

The specific content is controlled by the set of instructions referred to as product settings. Two primary attributes of the product settings are which forecast points to include in the product and which product category to generate. For routine products, the forecast points to include are usually pre-defined; for non-routine products, the recommendations provide the initial definition of which forecast points to include, which the user then customizes. In any case, the user can either accept the RiverPro recommendations for these two settings or can customize them.

Once these are decided, the next step is to define the specific contents of the chosen product. Again, the program makes recommendations which the user can accept or can customize. These settings are grouped by the various sections/subsections that are generated in the product. A list of the product sections is given below. A given product can include any combination of these sections, in any order. The only section that is mandatory is the product header section, and it is always included first.

The figure below lists all those sections that can be included in products. Note that for NWR/CRS products, the header section is handled differently.

1) Product Header section - identifies the product category, issuing office, etc.

2) Basis section - describes the hydrometeorological basis for the information contained in the product.

3) Summary section - briefly summarizes the hydrologic conditions in the river basin(s) and the purpose of the product; this section also has an associated prologue preceding it.

4) Tabular section - presents data for locations in a tabular form.

5) Point-specific section - for each forecast point; consists of three sub-sections:

   5a) Data Roundup subsection - presents data in narrative form.

   5b) Impact Statement subsection - describes the impact of the flooding

   5c) Historical Comparison subsection - compares flood with previous flood crests.

6) Call-to-Action section.

Figure 2 -1 RiverPro Product Sections/Sub-sections

Each section/subsection has a template that defines its specific content. The choice of which template to use is one of the primary instructions in the product settings.

2.4 Generation of Product Text

At this point, the desired product and forecast points to include have been specified and the product settings such as which templates to use have been specified. The product is now generated using these instructions and the templates themselves.

The template phrases consist of fixed text interspersed with template variables. To assemble a phrase, the value of the variable, whether it be a string or a number, is used to “fill-in-the-blanks". Then the phrases are concatenated to form readable

product text. Also, the values of these variables can be used in conditional expressions that determine whether a given template phrase is included in the product.

If the corresponding product is officially issued, as described later, the carryover data is created and stored for use in future product generatio. A sample of an actual product generated by RiverPro is given below. Note that editing of the basis section is required.

```
OKZ007>008-012>014-016-022-TXZ018-028-ARZ019-027-181200-
RIVER FLOOD WARNING
NATIONAL WEATHER SERVICE SILVER SPRING OK
ISSUANCE NUMBER 4
0819 AM EDT WED AUG 17 1994

THE FOLLOWING RIVERS ARE COVERED UNDER THIS FLOOD WARNING: UPPER TEST RIVER
AND LOWER TEST RIVER.

FOR THE UPPER TEST RIVER, MODERATE FLOODING IS FORECASTED TO OCCUR.  RIVER
LEVELS ARE RISING...FOR THE LOWER TEST RIVER, MODERATE FLOODING IS FORECASTED
TO OCCUR.  RIVER LEVELS ARE RISING...

THE CURRENT WEATHER IS DOMINATED BY A [...].  THIS WEATHER SYSTEM WILL PRODUCE
RAINFALL AMOUNTS RANGING FROM [...].  THE EXTENDED OUTLOOK IS FOR [...].

             FLD  OBSERVED        FORECAST 6AM    CREST
LOCATION     STG  STG  DAY TIME   THU    FRI      STG   TIME

UPPER TEST RIVER
 BLACK CITY  17  14.5 WED 07 AM  18.0   15.7     18.5  THU 06 AM

LOWER TEST RIVER
  DOVINGTON  17  17.5 WED 07 AM  14.5   12.5     20.0  WED 06 PM
  ONEODA     17  15.5 WED 07 AM  16.1   14.9     18.0  WED 12 PM

FOR BLACK CITY, THE LATEST READING IS 14.5 FEET AT 07 AM WEDNESDAY.  MODERATE
FLOODING IS FORECASTED, WITH A MAXIMUM STAGE OF 18.5 FEET AT 06 AM THURSDAY,
WHICH IS 1.5 FEET ABOVE FLOOD STAGE.  THE RIVER IS EXPECTED TO RISE ABOVE THE
FLOOD STAGE OF 17 FEET AT 01 AM THURSDAY AND FALL BELOW FLOOD STAGE EARLY
FRIDAY.  AT 17.0 FEET, EXPECT MODERATE FLOODING OF FARMLAND.  THIS CREST
COMPARES TO A PREVIOUS STAGE OF 17.9 FEET ON MAR 5 1993.

FOR ONEODA, THE LATEST READING IS 15.5 FEET AT 07 AM WEDNESDAY.  MODERATE
FLOODING IS FORECASTED, WITH A MAXIMUM STAGE OF 18.0 FEET AT 12 PM WEDNESDAY,
WHICH IS 1.0 FEET ABOVE FLOOD STAGE.  AT 18.0 FEET, EXPECT MODERATE FLOODING
OF RIVER PARK AREAS AND STRUCTURES.  THIS CREST COMPARES TO A PREVIOUS STAGE
OF 18.2 FEET ON FEB 22 1990.

FOR DOVINGTON, THE LATEST READING IS 17.5 FEET AT 07 AM WEDNESDAY.  MODERATE
FLOODING IS FORECASTED, WITH A MAXIMUM STAGE OF 20.0 FEET AT 06 PM WEDNESDAY,
WHICH IS 3.0 FEET ABOVE FLOOD STAGE.  THE RIVER IS EXPECTED TO FALL BELOW
FLOOD STAGE AT 04 PM WEDNESDAY.  AT 17.0 FEET, EXPECT MODERATE FLOODING OF
MAIN STREET.  THIS CREST COMPARES TO A PREVIOUS STAGE OF 19.0 FEET
ON DEC 28 1968.

DO NOT DRIVE CARS THROUGH FLOODED AREAS...STAY TUNED TO DEVELOPMENTS BY
LISTENING TO NOAA RADIO...
```

Figure 2-2 Sample RiverPro Product

2.5 Editing the Product

Editing of the product generated by RiverPro is supported within RiverPro. If the output product is edited, changes should be made only to the style aspects of the product. The following components of the product should not be changed via the editor:

- The numeric values included in the product such as the forecast and observed stages, stage categories or times, etc.

- The forecast points that are being included within the product.

Changes to the numeric data should be made in the IHFS database, so as to change the data at its source and ensure consistency among all the applications using the data. Adding a reference to a non-included forecast point, or removing all references to an included forecast point corrupts the integrity of the carryover data used by RiverPro. This will cause the RiverPro recommendations to be unreliable the next time the RiverPro application is executed.

When a user requests an edit of the RiverPro product, RiverPro uses the whfs_editor script to invoke an external edit session. This script simply initiates an edit session using the product filename provided by the RiverPro invocation of the script. The user can customize this editor script to control which editor is used, and how it is used.

2.6 Issuing the Product

After the product is reviewed, the user can request the product be issued. This invokes a WHFS Unix script named rpf_issue with the following six arguments:

1) Product Filename -

   The name of the work file to be issued. When RiverPro generates a product, it is simply writing a text file. This “work” file is written to file: /awips/hydroapps/whfs/local/data/product/ rpf_product.pid. The pid is the process id of the RiverPro process generating the file. This ensures that multiple sessions of RiverPro can run at the same.

2) Product Identifier -

   The product identifier is controlled by the user via the product settings. For official products, this is the 8-10 character identifier. The AWIPS form of this identifier MUST be used for the product to be disseminated properly. Do not use the AFOS form of this identifier!!! For NWR/CRS products, the identifier MUST match the 9-character product identifier expected in the NWR/CRS database, as discussed in Section 5.3.

3) Product Class -

Indicates whether the product is an official product or is for the NWR/CRS, as controlled by the user via the product settings. Its value is “OUP” for official user products, or “NWR” for NWR/CRS products.

4) Issue Mode -

This indicates whether the issue is being invoked in test mode or normal mode. When in test mode, the script will perform the actions specified in the script, which can be modified locally by each office. The default behavior is that if in test mode and the product is an OUP product, then the issue script sends a copy of the product to the test database; no other action is taken. If in test mode and the product is a NWR product, the no action is taken by the issue script. However, the issue request will result in the RiverPro work file being split into the products specific to each NWR tower, which can be reviewed by a knowledgeable user in the appropriate Unix directory.

When issuing in test mode, RiverPro will NOT refresh the dynamic data, nor update then recommendations, nor save the carryover, nor save the product to the IHFS database table used for storing text products (Textproduct).

5) Product Destination -

This indicates whether the product is for the local office or is for a non-local office. The value of this argument is either “LOCAL” or “NONLOCAL”, and is managed internally by RiverPro. All official products are considered to be for the local office. However, NWR/CRS products can be for the local office or can be for a neighboring office. This depends on which office is the controls the NWR/CRS transmitter for which the RiverPro product applies.

For the case where a WFO must issue products that pertain to forecast areas that are covered by a neighbor WFO's CRS tower, the rpf_issue script will send such products over the AWIPS WAN to the neighbor WFO where they will be captured and sent to the CRS of that neighbor. The initial configuration of this feature results in these products being directed to the NWRBrowser on the neighbor system as pending, whereupon the product can be interactively sent to the neighbor CRS. The initial configuration can be changed, if desired, to have the products received from a neighbor system be immediately sent to the host CRS, without the

requirement for human intervention on the host system.

6) WFO Identifier -

Three-character identifier of the controlling office for NWR/CRS products. This is defined for each transmitter in the IHFS database. In Build 4.3, this field is used to determine which office to send NWR/CRS products.

If the rpf_issue script is invoked for an official product, then the script uses an AWIPS script named handleOUP.pl to disseminate the product. This script performs ALL functions related to sending the official product to the appropriate destination(s). Its actions generate logfile(s) which should be reviewed if any problems are noticed with the product dissemination.

If the rpf_issue script is invoked for a local NWR/CRS product, the AWIPS script transferNWR is used to post the product to the NWR/CRS. If sending an NWR/CRS product for a non-local office, then rpf_issue uses the AWIPS script distributeProduct to transmit the product to the neighboring office, which then uses transferNWR to post the product to its NWR/CRS.

Please refer to the comments in the rpf_issue script, or to the WHFS web page, for information on the product identifiers and the logfiles involved with the dissemination of the official and NWR/CRS products.

The RiverPro interface provides an option for reviewing the Product Issuance log file. This allows review of the messages related to product issue requests, whether for OUP, NWR, or test products.

2.7 Non-Interactive Execution of RiverPro

Traditionally, RiverPro was run in an interactive mode, following the steps outlined in the previous sections. A new feature has been added to run RiverPro in a non-interactive mode. Typically, the non-interactive runs of RiverPro would be performed for a routine product. Currently, this new feature is not available for NWR/CRS products.

The new application, called rpf_batch, that supports this feature is invoked with a set of command line arguments. One of these arguments that specifies the name of the product settings file, which has all the high-level instructions on how to create the output product. By the way, these options can be modified and saved using the Settings options in the interactive version of RiverPro.

A sample script, run_rpf_batch, is also provided with the application to demonstrate how this new feature could be exploited.

The rpf_batch application supports the following command line arguments:

1) Database Name

   This is the name of the IHFS database to use, typically given as hd#_#xxx, where #-_# is the version number of the database, and xxx is the host office identifier.

2) Product Output File Suffix

   A user-designated string that allows explicit control over the names of the generated product and log files created by RiverPro. This is very helpful when setting up the script which issues the product. If not specified, the process id number will be used

3) Product Settings File Name

   The path and filename of the product content control file to be used in the generation of the product. If not specified, the default settings file associated with the RiverPro recommended product will be used.

For more details on the usage of the non-interactive RiverPro, including how to configure and schedule its automatic execution and product issuance functions, refer to the WHFS web page.

2.8 RiverPro Message File

During the course of executing RiverPro, various messages are logged to the message log file. This file is displayable to the user by selecting options provided in the user interface. The messages contain different levels of information, including warning, error, and fatal condition messages, and general messages regarding the execution of RiverPro. Warning messages are often informational in nature and do not necessarily mean there is an actual problem. Error messages are more symptomatic of a problem that should be at least reviewed, and possible corrected.

The file also contains status messages that indicate the program is performing some operation or that give the value of some program setting. It also includes messages which show the raw output of the product generation process, before the word wrap function manipulates the output to form paragraphs.

A message file is written during each session of RiverPro. The filenames include the id of the shell process executing RiverPro, thereby ensuring unique log files even if more than one RiverPro session is underway. These files are purged on a regular basis by a separate application.

2.9 Time Zone Issues

RiverPro uses many time stamps throughout its operations. This includes the times shown in the user interface, the generated output product text, and the time specification given in the files that contain the product settings and template.

In general, the time stamps given in the user interface and the product output are represented as local time. The one exception is the expiration time used in the Universal Generic Code (UGC) contained in the product header generated by RiverPro. This time is given in GMT.

There are variables and control settings in RiverPro that require the user to specify time values. For the time values in the SPECTIME template record and the timephrase file, as discussed later, GMT times are used. Special variable specifications referred to as physical-element variables are supported In the tabular section that allow the user to specify retrieval of data for any location and any physical element. These variable definitions also expect the time to be specified in GMT time.

The local time is defined for all WHFS applications, including RiverPro, by defining the Unix environment variable $TZ. The TZ environment variable dictates the local time in reference to the GMT time. Currently, RiverPro only supports one time zone setting. This means that all locations being considered by RiverPro are assumed to be in the same time zone. Because this is not always the case, an enhancement is planned that will allow data for locations in different time zones to be properly time-stamped.

3.0 Method for Determining Recommendations

RiverPro analyzes the available data and automatically determines recommended settings for all aspects of the product generation process. This includes the following two primary recommendations:

- Product category.
- Forecast points to include.

This section discusses the methods by which RiverPro determines the recommended values for these two items and other product settings. If you are not interested in how these recommendations are computed, this section can be skipped.

As discussed previously, RiverPro recommends the product category as either RVS, terminating FLS, FLS, or FLW, even though it is capable of generating products with other product categories. Also, RiverPro only considers forecast points when determining the recommended points for inclusion, even though it is capable of including locations other that forecast points. Lastly, when determining the recommendations, RiverPro makes use of the history of previously issued products (i.e. "carryover" data). For this purpose, RiverPro only considers officially issued products; products issued for the NWR/CRS are not considered.

The recommendations can be accepted as is or they can be modified by the user. The recommendations are an attempt by the program to determine the hydrometeorological state, and from it recognize the most-severe level of flooding that may be occurring or is forecast, and then define the product settings so that the appropriate product can be generated. These recommendations are just that - they are recommendations. Users are encouraged to review and customize the product settings in any manner they wish.

The primary recommendations are determined by an algorithm that is described in the following sections. This algorithm is controllable by the user only in the sense that the user defines the flood categories for a forecast point. The RiverPro interface dedicates a full window to displaying information regarding the recommendations. Refer to this display if questions arise regarding the recommendations - it can be very informative.

Other subsequent recommendations are also performed by RiverPro. The recommendation of which impact statements and crest comparison references to include for each forecast point can be configured through a set of switches defined by the product settings associated with the product category.

3.1 Values Used by the Recommendation Process

To determine the recommendations for the product category and included forecast points, three values for each forecast point are used. The three values from the carryover data and the current stage data include:

- Previous product category for the forecast point.

  The previous product information is defined from previous issuances of products via RiverPro. The product category of the product which last included the forecast point is tracked in the database. The value is read and used in the recommendation algorithm. If a value is not available because a forecast point is new or the application is being run for the first time, the previous product is assumed to be an RVS.

  When determining the previous product, RiverPro may not necessarily use the most recent product; rather, it uses the most "representative" recent product. Specifically, if a terminating FLT, FLS, or FLW is the most recent product, then it is considered the most representative. If an FLW or FLS is issued without ever having been followed with a terminating FLS, even though RVS products or other products may follow, then the FLW or FLS is considered the most representative. This approach allows the proper recommendation of a terminating FLS when appropriate.

- The maximum stage category for the forecast point.

  This maximum stage value is the maximum of the current observed or maximum forecast stage. At least one observed or forecast value must be available to compute this value.

- Whether the forecast point experienced a rise in stage category compared to the last issuance.

  This variable is referred to as the rise-fall flag. It represents whether a rise in stage category has occurred (i.e. True/False) when comparing the current maximum stage category with the maximum stage category for the forecast point at the time of the previous product. To compute this value, both the values mentioned above in items 1 and 2, must be available. Note that this flag is based on the stage category, not the actual stage value. As an example, if in the previous product the forecast point was experiencing minor flooding, and now is experiencing major flooding, this rise-fall flag is True.

3.2 Recommending the Product Category

The rules for determining the product category are given here. Inherent in these rules is the notion that all Flood Statements (FLS) or Flood Warnings (FLW) must be terminated by a "terminating" Flood Statement ("FLT"). The abbreviation of FLT is simply for internal identification purposes only; there is no such NWS product.

Stage categories are used throughout the recommendation process; where the stage categories are non-flood, minor, moderate, major, and record, and are read from the database. Typically, the minor stage category is set equal to the flood stage. The record stage is defined to be the maximum crest value defined in the IHFS database when only considered crest values that are designated as "suppressed" in the database. The other categories are explicitly defined in the database.

An algorithm is used to determine the recommended product for each forecast point. These forecast point recommendations are then used later to determine the overall recommendation. The algorithm is presented below in pseudo-code form.

```
IF (the maximum stage category is the non-flood category) THEN
{
     IF (the previous product is an RVS or terminating FLS) THEN
               RVS product is recommended; this represents a non-
               flood situation.

     ELSE IF (the previous product is either an FLS or FLW) THEN
               Terminating FLS product is recommended; this
               represents a flooding condition which is no longer
               occurring but needs to be acknowledged as having
               terminated (i.e. a terminating flood situation).
}

ELSE IF (the maximum category is above the non-flood category)
THEN
{
     IF (the previous product is an RVS) THEN
               FLW is recommended; this represents new flooding.

     ELSE (the previous product is an FLS or FLW) THEN
     {
               IF (the rise-fall flag indicates no rise from one
               category to another) THEN
                    FLS is recommended; this represents continued
                    flooding.

               ELSE IF (a rise did occur) THEN
                    FLW is recommended; this represents newly
                    identified, or additional flooding.
     }
```

```
}
```

A product category is recommended for each forecast point. The next step is simple - the most severe product of all the forecast points is the recommended product category. This is a conservative approach which results in an FLW being recommended even if only one forecast point was recommended for the FLW. The products ordered from least to most severe are: RVS, terminating FLS, FLS, FLW.

3.3 Recommending the Forecast Points to Include

The method for recommending which forecast points to include is based on the overall recommended product category and the product category recommended for each forecast point. Note that a forecast group is considered to be included if one of the forecast points within the group is included; this is used to determine which forecast groups are included in the summary section of the product.

For each of the product categories that can be recommended, the rules for including points are described below. Again the algorithm is given in pseudo-code form.

```
IF (RVS is the recommended product) THEN
     all points are recommended for inclusion except those that
     have no stage data available.

ELSE IF (Terminating FLS is the recommended product) THEN
     only those forecast points having a recommended product
     category of FLT are included.

ELSE IF (FLS is the recommended product) THEN
     only those forecast points having a recommended product
     category of FLS are included.

ELSE IF (FLW is the recommended product) THEN
     only those forecast points having a recommended product
     category of FLW are included.
```

3.4 Recommending the Product Settings

Based on the recommended product category, RiverPro loads in an initial set of product settings. These settings are contained in a text file and include the values of many switches and options, and the templates to use for each of the product sections/subsections. There is a default file for each of the four product categories (including the terminating FLS) that can be recommended by the program.

The settings contained in the default settings files can be adjusted by the user as

desired. The user interface allows the user to review, modify, save, and delete the information in the product settings file.

Besides the product category and included forecast points, there is an additional set of recommendations performed by RiverPro. These are the recommendations for the impact statement and historical crest references to include in the appropriate product sections. For a given forecast point, these recommendations are based on comparing the maximum stage with the impact statements and historical crests available in the database, in a manner controlled by a collection of options defined in the settings file. The details of how these settings affect the recommendations are discussed in Sections 4.6.2 and 4.6.3.

3.5 Recommending the Issuance Number

RiverPro allows the user to insert the value of variables in the generated product. One variable that can be used for the product header section is the issuance number of the product. A value is recommended for this variable by RiverPro, or the user can manually enter a value. The method by which the recommended issuance number is derived uses the algorithm described below in pseudo-code.

```
IF ( the product being generated is an RVS) THEN
     Issuance number = 0

ELSE
{
     The most-severe previous product is determined.
     [This is done by checking the category of the previous
     product for each of the forecast points included in the
     current product.  For example, if the 4 points in the
     current product have a previous product category of: RVS,
     FLS, RVS, and FLW, then the most severe product is the FLW.]

     IF (the most-severe previous product is an RVS or a
     terminating FLS) THEN
          Issuance number = 1

     ELSE IF (the most-severe previous product is an FLS or FLW)
     THEN
     {
          The highest issuance number of the previous products is
          determined.
          [For each forecast point included in the current
          product, RiverPro checks the issuance number of the
          previous product which contained the forecast, provided
          that the product was not a terminating FLS.  The
          maximum of these for all forecast points is found.]
```

```
            Issuance number = this highest previous issuance number
            + 1
      }
}
```

4.0 Generation of Official Products

This section explains in gruesome detail how each of the sections and subsections for official products is generated. The generation of products for NWR/CRS broadcast is discussed in Section 5.0. The primary difference between the two product classes is in how the information is organized in the product. The two methods use the same basic process and share major sections of software to perform their task.

In summary, the generation of a product is controlled by the following three entities:

- Product settings.

  The instructions are initially defined based on the product category selected, which is based on the recommended product or is manually selected by the user. The user interface allows customization of their contents. Alternatively, a new set of instructions can be loaded and then the instructions can be customized. If desired, the customized instructions can be stored as a new collection of settings for future use, or they can be updated within the same collection settings. The products settings are stored in text files manageable via the user interface. A complete list of the product settings file is given in Appendix C.

  The product settings dictate such things as which product sections/subsections to include and which templates to use for each of the sections/subsections. It can contain explicit instructions as to which forecast points the product should include, although this option is normally not exercised, and when it is, it is usually used only for routine products such as an RVS. Typically, the included forecast points are based on the recommendations or by the user selecting a set of forecast points to include. The product can contain locations other than forecast points in the tabular section.

- Phrase templates.

  The phrase templates contain a collection of records, with different record types controlling different aspects of the phrase generation process. Each record is contained on one line of the template file, unless continuation lines are used to extend the record definition onto multiple lines. In the template, there are phrase records that contain the actual

phrases for inclusion, there are condition records that given the conditional expression associated with a given phrase, and there are other record types with special purposes. Each record is defined by a keyword, following by keyword values on the same line of the template file. The complete set of template records are described in Appendix A, and a discussion of how the templates are processed is given in Section 6.0.

RiverPro processes each of the records found for the chosen template contained in the template file. Note that the template files contain all the available templates for a given section/subsection; each template in the file is uniquely identified by its template name at the beginning of the template.

The templates themselves are constructed beforehand and cannot be changed from the user interface. They must be changed via a text editor external to RiverPro.

- Data values.

  Data values themselves for the stage and other data types play a role in controlling the product content. Some of the templates allow data-based conditions to be associated with a given phrase so that the phrase is generated only if the condition is met. In this sense, the data values themselves can control the product content.

Once the product settings are defined, the product is generated based upon its instructions. Data values are used when processing the phrase templates, which are selected as part of the product settings, in order to create the output product. Together, these three entities interact to control the generation of the final product.

The discussion on the following pages concentrates on how the product settings and templates control the formatting process. The means by which the interface manipulates the product settings is not discussed. During parts of this discussion, it may be helpful to reference the appendices which detail the features available in the product settings and the templates. The discussion is organized by product sections/subsections.

4.1 Product-Wide Instructions

Before describing the generation of a each product section/subsection, the instructions

which apply to the product as a whole must be covered.

First, the product identifier is associated with the product. It follows the NWS form of CCCCNNNXXX for official products. The identifier is provided to the communications interface that transmits the issued product externally, which adds the product identifier to the product header. See Section 2.7 for more information on issuing products. Note that for NWR/CRS products, the product identifier is defined using different guidelines.

In addition to the product identifier, a product category (i.e. NNN) is also defined. It is used to track the product issuances over time in terms of the carryover data used for the recommendations. Typically the product category (NNN) matches the NNN portion of the product identifier (CCCCNNNXXX). To allow flexibility, it is maintained independently from the product identifier even though the category is part of the identifier.

Which forecast points to include can be specified. Individual forecast points are referenced in the product within the tabular section and the three subsections of the point-specific section. For those forecast groups which have at least one of their points included in the product, the forecast group is referenced in the summary section.

Which sections to include and their order in the product are controlled. If the point-specific section is included, the user can specify which subsections of this section to include and their order.

The case of the product text can be defined. The user can force all product text to be uppercase. Alternatively, the user can allow mixed case. In this mode, the case of the template phrases and database-supplied values are left unchanged. For the text that is provided by RiverPro, such as the stage category names and the day-of-the-week, mixed-case names are given.

4.2 Product Header Section

The product header section is always included at the beginning of a product. The product settings define which template to use. The template is processed and the resulting text is written to the output product. The header section templates supports variable substitution, so the template phrases are loaded with any variable values and then inserted in the output text. Each template phrase is written to a new line - i.e. no word wrap is performed.

Note that there is a specific time format intended for use in the header section. The T_HEADER format is described in the discussion of template formats in Appendix A. A list of Universal Generic Codes (UGCs) can be inserted into the header. This list is an

aggregate of the zone or county numbers specified for the included forecast points, followed by the expiration time.

The WMO header should NOT be added to the header template since it is inserted automatically by external communications functions, using the product identifier discussed in the preceding section.

4.3 Basis Section

The basis section is only included if it is specified for inclusion. Its order is determined by the specified order. Because the basis template only provides for the insertion of fixed text (i.e. no variable substitution is supported), it usually requires editing.

The user can specify which template to use. This template is processed and the text is written to the output product. The template phrases are written to the output product with no variable substitution. If multiple phrases are given in the template, the phrases are concatenated so as to form a paragraph.

4.4 Summary Section

The summary section is only included if it is specified for inclusion. Its order is determined by the specified order. The summary section is actually composed of two parts - a prologue and the forecast group phrases in the body of the section.

4.4.1 Summary Prologue Subsection

The prologue is generated using the specified template. The name of the prologue template must contain the string “PROLOGUE” as part of its name. If a valid prologue template is specified, the prologue is written first, before the summary body. This prologue is intended to contain information that is not specific to a single forecast group. Therefore, variables such as <GrpId>, which gives the forecast group id, are not permitted. The prologue contains information that addresses all locations included in the product. Typical prologue subsection variables include a list of the rivers or counties being considered in the product. After the prologue, the main body of the summary section is written.

4.4.2 Summary Body Subsection

RiverPro loops on each of the forecast groups when generating the body of the summary section. The template specified for the forecast group is processed and the resulting text is written to the output product. Unlike the summary prologue section, the template used for the summary body can and should include variables specific to forecast groups. A single template can be used for all forecast groups, or if desired, the user can specify a unique template for a particular forecast group.

Only forecast groups that have at least one of its forecast points included in the product are considered in the summary section. Because the summary template supports

conditional control, it is possible to set up specific conditions under which the phrases are included. The text generated for each forecast group is concatenated so as to result in one paragraph for the entire summary body.

4.5 Tabular Section

The tabular section is only included if it is specified for inclusion. Its order among the product sections is controlled by the specified order.

The tabular section is created using the specified template. For a specific forecast point to be included in the tabular section, the forecast point must be specified for inclusion in the product. Locations other than forecast points can be included in the tabular section by using the <ObsPe> type variable which is covered later in the discussion of the template variables.

The tabular template is processed sequentially (i.e. "on-the-fly"). The tabular template supports many record types (i.e. different keyword at the beginning of the line). The records that trigger output are:

- LITERAL - Writes literal text that follows the keyword.
- FP_ID - Writes text for the forecast point id that follows the keyword, using the information previously defined in the FORMAT and VARIABLE records.
- MISCWRT - Write miscellaneous data not specific to a forecast point, using the information previously defined in the FORMAT and VARIABLE records.
- GRPNAME - Writes the name of the forecast group currently being processed.

When the LITERAL record is encountered, the text following the keyword LITERAL: is inserted in the output product.

When an FP_ID record is encountered, this triggers text generation for the forecast point identifier that follows the keyword. The specific information that is generated is determined by the FORMATS and VARLIST template records that precede the FP_ID record. The format specifiers that follow the FORMATS keyword are processed one at a time. The format item may instruct RiverPro to insert blank spaces or insert a quoted string. If the format item is for a variable, whether it be a float, integer, time, or string variable, then the list of variables in the VARLIST is referenced. The first format item for a variable is used to format the value for the first VARLIST variable, the second format item for the second variable, etc. This process continues until all format items have been processed for the FP_ID.

Note that there can be a unique definition of the paired FORMAT-VARLIST instructions preceding each FP_ID record, that differ for each forecast point. Alternatively, the FORMAT and VARLIST records could be defined once, then followed with multiple FP_ID records, causing all of the forecast points to use the same FORMAT-VARLIST instructions when writing the line of text.

When a MISCWRT record is reached, then an output string is generated based on the FORMATS and VARLIST, similar to the method described above for the FP_ID record. The difference is that the variables specified in the VARLIST record are variables that are not associated with a forecast point. This is useful for including such variables as the day-of-the-week in a header of the tabular section.

The GRPNAME template record also results in text being generated. When specified, the name of the forecast point's forecast group is inserted as a left-justified header anytime that the subsequent FP_ID forecast point implies a new group is being processed. This is used for putting the group name on a line by itself, and thereby acting as a informative heading for the forecast points that are listed on subsequent line. Following the GRPNAME keyword is a value that indicates whether to write a blank line in the output product above the line with the group name header.

All tabular templates are processed until the end of the template is reached. If a forecast point is included in the product, but did not have a FP_ID record for it in the tabular template, then RiverPro automatically adds the forecast point information to the end of the tabular section. The last-specified variables and formats, as defined via the last VARLIST and FORMATS records, are used for when writing the text for the forecast point. Because these may not be the information that is desired for the forecast point, it is preferable to have all forecast points be referenced by an FP_ID record. This automatic feature is provided in the event that a forecast point is not explicitly listed in the tabular template.

4.6 Point-Specific Section

The user controls whether to include the point-specific sections, and its order in the product. RiverPro loops on the included forecast points as part of the process of generating the point-specific section. Any text generated for the point-specific subsections for the given forecast point is concatenated so that one paragraph is generated for the point-specific section for each forecast point.

4.6.1 Data Roundup Subsection

The data roundup section is only included if specified. Its order within the point-

specific section is set by the specified order. The data roundup templates support conditional control to allow tailoring of the phrases to the current hydrologic conditions.

A single template can be specified for use for with all forecast points. Alternatively, a unique template can be specified for a particular forecast point. As an example, a special template might be employed for a forecast point if it has consistently unique hydrologic conditions or unusual data available that won't allow the standard phrases to be generated as they are for the other forecast points.

4.6.2 Impact Statement Subsection

The impact statement section is only included in the output product if specified for inclusion. Its order within the point-specific section can be specified. The templates for this subsection allow variable substitution, but not conditional control.

The name of the template to use are specified. The same template is used for all forecast points; there are no means by which a unique template can be specified for a individual forecast point. This encourages similar phraseology for all impact statements for all the forecast points.

For each forecast point, an impact statement(s) is recommended by the program automatically or the user can explicitly choose an impact statement(s). The method by which this recommended impact statement(s) is determined as follows:

The program uses a reference stage, which the user can select as being either the current observed stage, the maximum forecast stage, or the maximum of the two. First, the reference stage is checked to make sure it is not too far below the flood stage. The user controls this maximum number of feet that the reference stage can be below the flood stage. If the reference stage is too low, no impact statement is recommended. For example, if the flood stage is 20 feet and the maximum limit is 4 feet below flood stage, then if the reference stage is 15 feet, no impacts will be recommended.

RiverPro then searches for an impact statement(s) that applies has a stage that lies within a stage window that the user controls. The limits of the stage window are defined with regard to the reference stage. The upper and lower limits of the stage window are then found by adding an upper and lower offset values. As an example, if the reference stage is 27.1 and the stage window offsets are -2.3 and +2.0, then the stage window is from 24.8 to 29.1.

Impact statements are also screened based on seasonal requirements. Each impact statement has an associated season of a year for which it applies, bounded by a start date and an end date. The season may be defined as a single day, the entire year, or any duration in between. Also, it may straddle two years by having January 1 lie

between the start and end dates. If the current day of the year does not fall within the season defined for the impact statement, then the statement is not included.

RiverPro uses a search mode controlled by the user, which can be set to use the highest stage value within the stage window, or use the stage value that is closest to the reference stage be used. This modes result in at most one impact statement being selected. Alternatively, a mode is available that dictates that RiverPro use all impacts below the upper limit of the stage window to be used. In this mode, multiple impact statements can be selected.

By applying the search mode to query all those impact statements whose stage and time-of-year pass the above-described filters, RiverPro selects the recommended impact statement(s).

4.6.3 Historical Comparison Subsection

The historical comparison section is only included in the output product if specified. Its order within the point-specific section is determined by the specified order. The template for this sections support variable substitution, but not conditional control.

The name of the template to use and the forecast points to include can be specified. The same template is used for all forecast points; there are no means by which a unique template can be specified for a individual forecast point.

For each forecast point, a historical crest is determined by the program or the user can explicitly choose a crest. When considering which of the available historical crests to use, all crest values that are designated as “suppressed” in the IHFS database definition for the crest are ignored. Furthermore, they are not available for manual selection by the user.

The method by which the recommended historical crest is determined as follows. The program uses a reference stage and checks that it not less than some amount below the flood stage This is done in the same manner as is done for recommending impact statements, as described in the previous section.

The user controls the different search modes available for finding the single recommended historical crest. The search consider all crests that are within a specified stage window and, optionally, also within a specified time window. The stage window is defined in the same manner as for impact statements, as described previously. The time window is defined as the number of years to "lookback' from the current year. For example, if the value is 30 and the current year is 1994, then the time window is bounded by 1964 and 1994.

Different search modes can be specified for the stage and time windows. If the mode specifies use the most recent crest in the windows, then the most recent historical crest that lies within both the stage and time window is used. Another mode uses the crest closest to the reference crest, and whose value and time is still within both windows.

Some of the search modes do not use the time window. A search mode is available that uses the most recent crest that is within the stage window. Another mode uses the crest that is closest to the reference stage while still within the stage window. Lastly, another mode uses the highest crest found within the stage window. If no crest value meets the search criteria, then no historical comparison is recommended for the forecast point. Using the stage and the time windows as instructed, RiverPro uses the specified search mode to find the recommended historical crest.

4.7 Call-to-Action Statement Section

The call-to-action section is only included in the output product if specified. Its order in the output product can also be specified. The only information used for the call-to-action section is the list of templates. This list may include up to 5. Each template is inserted verbatim into the output product; no variable substitution is supported. Multiple templates are concatenated together to form a paragraph.

5.0 Generation of NOAA Weather Radio Products

This section explains how RiverPro generates products for the NWR/CRS. Most of the text generation processes for generating NWR/CRS products are identical are identical to those discussed in Section 4.0 for official product generation. In fact, this section only discusses the differences between generating official product versus generating NWR/CRS products.

These differences are attributable to the fact that NWR/CRS products are for transmission to NWR CRS units, which take the “broadcast-ready” text and voice-synthesize it for broadcast over the NWR towers controlled by the CRS. Although RiverPro now allows a tabular section to be incorporated in a NWR/CRS product, the user should be aware that tabular text destined for the NWR/CRS must use a format that can be properly interpreted by the CRS unit.

Because the products must pass through the CRS unit, rather than conventional circuits, the header for NWR/CRS products is unique. Lastly, because each radio tower’s signal can be received within a limited area only, the products are organized so that a product is created for each tower, and it contains only those locations which describe events within the signal area. A given location may appear in multiple products because of overlapping signal coverage.

5.1 Selecting an NWR/CRS Product

This section discusses how the user requests that a NWR/CRS product be generated. A field in the product settings dictates whether a product is defined as an official product or a NWR/CRS product. Obviously, the value of this field is important. As with any collection of product settings, these are selected via the main screen of the RiverPro interface.

By design, RiverPro does not make recommendations for NWR/CRS products - it only considers the official products when making its recommendations. Therefore, an NWR/CRS will never be recommended so the only way to create a NWR/CRS product is to explicitly select product settings which are for a NWR/CRS product.

When customizing NWR/CRS products, the user follows the same process as followed for official products. The forecast points to include are selected, and then settings are adjusted as necessary. The user can save these settings for future recall. The product is then generated and the user then reviews the product file. This is where the differences are evident.

5.2 Organization of the NWR/CRS Product Work File

This section discusses the unique approach used in organizing the text in NWR/CRS products. For official products, the geographic area covered by the products includes a geographic area up to the size of the Hydrologic Service Area (HSA) for an office. For NWR/CRS purposes, the coverage area issues are much more involved. In addition to the notion of handling the products for locations in an HSA, a given office "controls" a number of NWR transmitter towers. Each of these tower's signal area probably overlaps at least one other tower's signal area.

RiverPro is designed to generate each product for the area of coverage defined for the applicable tower. Therefore, when writing the product text for a given forecast point, RiverPro generates either one or more products; a product is generated for each tower associated with the forecast point. When dealing with many forecast points, RiverPro creates many products, and probably each product has a different set of forecast points.

RiverPro preforms the bookkeeping operations necessary to organize the forecast points into the applicable products for one or more transmitters. This organization is accomplished by using geographic linkages defined in the IHFS database. Specifically, a given forecast point is associated with a one or more counties, then a given county is associated one or more transmitters.

RiverPro creates a product work file by considering all forecast points that are included in the product and determining which towers are referenced by virtue of the forecast point-county(s)-tower(s) relationships. Then for each tower considered, RiverPro writes all the product information for all forecast points that are associated with the tower. Each tower's work product is written to the same file. The user is then given the option to review this information, and if the user chooses to issue the product(s), the RiverPro component which performs the issuance will separate the various work products in the file and create separate products ready for broadcast.

As an example of the organization of the NWR/CRS work products, consider the following forecast point-to-county associations, and county-to-tower associations. The products for each tower would contain information for the forecast points as shown in the below figure.

ForecastPoint-to-County Associations:

ForecastPoint1 -> CountyA, CountyB
ForecastPoint2 -> CountyB, CountyC
ForecastPoint3 -> CountyD

County-to-Tower Associations:

CountyA -> TowerX, TowerY
CountyB -> TowerX
CountyC -> TowerZ
CountyD -> TowerY

Resulting Tower Product Contents:

TowerX work product - references ForecastPoints 1 and 2
TowerY work product - references ForecastPoints 1 and 3
TowerZ work product - references ForecastPoint 2

Figure 5-1 Organization of Sample NWR/CRS Work Product

An excerpt of a sample product work file generated by RiverPro is shown below. When it is issued, the work file is split into the actual products sent to the NWR/CRS and the comments are removed.

```
### This file contains a section for each NWR tower considered.
### Upon issuance, each product is parsed and issued.
###
### 10 NWR towers (controlling wfo) considered:
###  WWF42 (OUN) WWG46 (OUN) WXK20 (FWD) WXK22 (FWD) WXK31 (OUN)
###  WXK85 (OUN) WXK86 (OUN) WXK87 (OUN) WXK93 (DDC) WXL48 (OUN)
### note: locations included in product but...
### BLUO2-BLUE defined for a tower that is controlled by other wfo.
### DEKT2-DEKALB not defined for any tower.
###
### ***************** start of tower product ***********
PRODUCT_START: WWF42 NW5 OUN
### call_sign, city, wfo: WWF42, PONCA CITY, OUN
### locations defined for tower area of coverage:
### ONEO2,  GTRO2 (2 total)
###
T_ENGCCCRVSNW599020320459902032045        AD  NOKC083-119c9902042000

FOR THE CIMARRON RIVER NEAR GUTHRIE, THE LATEST STAGE IS 4.4 FEET
AT 11 AM WEDNESDAY.

FOR THE CIMARRON RIVER IN OKEENE, THE LATEST STAGE IS 4.4 FEET
AT 11 AM WEDNESDAY.
### ***************** start of tower product **************
PRODUCT_START: WXK87 N23 OUN
### call_sign, city, wfo: WXK87, ARAPAHO, OUN
### locations defined for tower area of coverage:
### ONEO2 (1 total)
###
T_ENGCCCRVSN239902032046902032046        AD  NOKC011-073c9902042000
```

```
FOR THE CIMARRON RIVER IN OKEENE, THE LATEST STAGE IS 2.3 FEET
AT 10 AM WEDNESDAY.
###
### ***************** start of tower product ************
### call_sign, city, wfo: WXK93, ENSIGN, DDC
### no locations defined for tower area of coverage.
###
```

Figure 5-2 Excerpt of Sample NWR/CRS Work Product

5.3 NWR/CRS Product Identifiers

This section discusses the critical role of the product identifiers and how they are defined. Each product in RiverPro has a product identifier defined for it, as discussed in previous sections. This product identifier has special meaning in the generation of NWR/CRS products. First, because of requirements dictated by the CRS units which receive the issued products, the product identifier must be exactly nine-characters, using the traditional NWS convention: CCCNNNXXX. The NNN portion is defined as the product category, such as RVS for river statement. The CCC is generally used to define the communications node for the product; for NWR/CRS products this definition depends on the local CRS configuration.

The XXX portion of the field takes on a very special purpose for RiverPro when generating NWR/CRS products. Two approaches can be used in defining the XXX field.

- The XXX value can be defined as the wildcard value “XXX”.

  The wildcard value indicates that RiverPro should generate a product for each of the towers which covers at least one forecast point that has been selected in the product settings. In this approach, the user need not be concerned with all the different forecast point-to-county(s)-to-tower(s) relationships. RiverPro performs all the bookkeeping functions to organize the product. This method is the one used to create the example product in the previous section.

  When creating the product work file, RiverPro writes a single file that contains one or more products. A “tower product” is written for the tower if that tower contains at least one forecast point that is included for consideration. If no forecast points are included that fall within the given tower’s area, then comments indicating this are written to the file. These comments are stripped out of the product work file later when it is issued.

  Also, the “XXX” wildcard indicator is replaced with the tower’s “product code”, as defined in the IHFS database and discussed later. The

resulting unique full product identifier is used by the CRS to control which tower this product is delivered.

- The XXX value can be defined as an absolute value.

  In this case, the product id is assumed to be a literal, and one and only one product, using the given product id, will be created. RiverPro will only create one product in the work file, using the full product identifier as specified, and will NOT substitute in the tower's "product code" for the XXX. It is critical that the definition of this literal identifier use the proper product code for the tower and defined in the IHFS database.

5.4 NWR/CRS Work File Content and Error Messages

This sections discusses the content of the generated product file, including some of the error messages which may be written to the file. The file begins with a collection of comments. All generated comment lines begin with the special indicator string "###".

RiverPro first checks certain definitions in the IHFS database pertinent to the NWR/CRS product generation process. If the wildcard feature for the XXX field is being used, then RiverPro checks to make sure that the tower product codes are all unique. If not the following message is written:

```
Duplicate product codes exist for transmitters!!
There are ## transmitters, but only ## unique codes.
Fix product code definitions in HydroBase ASAP!!
```

If there are no active transmitters defined that are associated with at least one forecast point, then the following message is written:

```
No active NWR towers associated with these
forecast points.  Product not written.
```

If the user specifies a literal product identifier and the tower product code implied by the XXX portion of the identifier is not assigned, then the following message is written:

```
Specific product code for tower not found.
Define the product code for the tower using HydroBase.
Product not written.
```

If the XXX portion of the identifier matches more than one tower's product code, then the following error message is written:

```
Duplicate product code for multiple towers!!
```

```
Only one product written.
Fix product code definitions in HydroBase ASAP!!
```

These error conditions should be remedied immediately, either by correcting the product identifier in the product settings, or by correcting the product code(s) via the HydroBase application. The product code defintions are very important in order to ensure that the products are sent by the CRS to the proper towers.

Next, RiverPro checks each of the included forecast points to see if they will be referenced by at least one tower's product by virtue of the forecast point-to-county(s)-to-tower(s) relationships. RiverPro writes comments to the file indicating the call sign and controlling WFO for each tower. Then each forecast point is checked for two conditions. First, if the forecast point is not defined for any tower, then a comment noting this is written as follows:

```
ID-ID_NAME not defined for any tower.
```

Second, if a forecast point is defined for a tower that is not controlled for the local office, then a comment is written as follows:

```
ID-ID_NAME defined for a tower that is controlled by another
WFO.
```

RiverPro then loops on all the towers that are active and writes the product text. If the tower has at least one forecast point included in the product, then the keyword record is written in the following form:

```
PRODUCT_START call-sign product-code controlling-WFO
```

The lines that follow indicate assorted fields associated with the tower, including which forecast points are being considered for this tower. After this is the actual NWR/CRS header, followed by the broadcast-ready text. This is repeated for each tower being considered. If a given forecast point is associated with more than one tower, the product text for that forecast point is generated for each tower.

If no forecast points are included that cover the tower area, then the following message is written:

```
no locations defined for tower area of coverage.
```

If a tower never will contain any forecast points in its area, the user should consider setting the tower to be inactive via the HydroBase application.

The user can edit the product text as necessary but should not edit the product header not the PRODUCT_START records. When issuing the product(s), a separate function

reads the product file and splits the file into individual products, and strips out the comment lines. Each of these products is then sent to the NWR via the rpf_issue script, discussed in Section 2.6.

5.5 NWR/CRS Product Header

The CRS unit which receives the text product from RiverPro processes the product according the definitions in the CRS database. In order for the CRS to determine how to process the product, the CRS relies exclusively on the header in the CRS file, which follows a very specific format. The two header fields listed below are particularly important for ensuring the product is accepted for broadcast on a particular tower. They are discussed further in Section 5.6, which describes user configuration.

1) Product Identifier

   The nine-character product identifier, whether it be a literal or formed by use of the wildcard substitution, must be defined in the CRS database in two respects (note that the CRS uses the term “message type” to refer to the product identifier). First, the identifier must be defined as a valid product, recognized by the CRS. This is contained in Block 10 of the CRS database and is definable via the CRS interface. Second, the product must be associated with the applicable tower, as defined in Block 15 of the CRS database.

2) Listening area codes

   The product header contains a field for the listening area codes for which this product applies. These codes are very similar to the Universal Generic Code (UGC) concept used for official NWS products. For a product to be accepted by a given tower, the header must include at least one county associated with the given tower. The county-tower associations are defined in Block 8 of the CRS database.

   The county-tower associations are also required to be defined in the AWIPS IHFS database. The associations defined in the IHFS database must agree with those in the NWR; if they don't agree, the products may not be accepted for the proper tower.

There are other fields contained in the header of the NWR/CRS product. A complete list of all the fields in the NWR/CRS product header is given below, with brief comments discussing how RiverPro manages the information.

- Message format - Defined in the product settings file; no RiverPro interface is provided.
- Product Identifier - Defined in the RiverPro product settings.
- Creation Time - Set by RiverPro to the current time.
- Effective Time - Set by RiverPro to the current time.
- Periodicity - Defined in the product settings file; this can be changed via the RiverPro interface.
- Message Reference Descriptor - Currently not used by RiverPro.
- Active Switch - Defined in the RiverPro product settings; this can be changed via the RiverPro interface.
- Delete switch - Defined in the product settings file; no RiverPro interface is provided.
- Confirm switch - Defined in the product settings file; no RiverPro interface is provided.
- Interrupt switch - Defined in the product settings file; no RiverPro interface is provided.
- Alert Tone/SAME - Defined in the product settings; this can be changed via the RiverPro interface.
- Listening Area Codes - Defined automatically by RiverPro based on the forecast point-to-county-to-tower relationships.
- Expiration Time - Defined based on default in the RiverPro settings; this can be changed via the RiverPro interface.

Figure 5-3 NWR Product Header Fields

5.6 Configuration of NWR/CRS processing

In order to support the end-to-end processing and broadcast of NWR/CRS products, both the WHFS system and the NWR/CRS unit must be properly configured. The WHFS system configuration includes the proper definitions of the IHFS database and of the RiverPro product settings.

To summarize the following items must be configured:

- The transmitter towers and the forecast point-to-county(s) and county-to-tower(s) relationships must be defined in the IHFS database.
- The product identifier must be specified in the RiverPro product settings.
- The county-to-tower(s) relationships and the product identifier must be defined in the CRS database, and must agree with the definitions in the IHFS database and in the RiverPro product settings, respectively.

The detailed configuration requirements are given below.

1) NWR Transmitter Towers in the IHFS Database.

   Each tower of interest must be defined in the IHFS database. An initial set of this information was provided. Only towers that are controlled by Weather Forecast Office (WFO) identifiers that were already defined in the database are loaded. Because an office usually has more than just their own WFO identifier defined, this initial list will probably include towers controlled by other offices and which do not cover any portion of the office's area of responsibility. If desired, the tower definition can be modified, removed entirely, or the tower can be made inactive.

   The tower product code field is critical in the definition of the NWR transmitter tower. Define each tower product code uniquely, and make sure that it matches the XXX portion of the product identifier expected in the CRS. The tower product code is used by RiverPro when using the wildcard for the XXX portion to form the product identifier. When using an explicit product identifier (i.e. no wildcard requested), then the XXX portion of the code is checked to make sure it matches a code defined in the database. The product identifier is discussed in Section 5.3 and in item 4 and 5 below.

   Management of the tower information in the IHFS database is done using the HydroBase application (select the Setup | NWR Transmitter option).

2) Forecast Point-to-County Relationships in the IHFS Database.

   These are defined in the IHFS database managed by the HydroBase application. Even in the absence of NWR/CRS support by RiverPro, they should already have been defined by each office because they are used to create the UGCs for the headers in official products. These relationships are not defined automatically; each office must configure this as necessary using the HydroBase application (select the Location | County/Zone UGC option).

3) County-to-Tower Relationships in the IHFS Database.

   These are defined in the IHFS database managed by the HydroBase application. An initial definition of these relationships was provided. This definition was defined using the county FIPS codes as specified in the IHFS database. If these codes were not defined, these relationships were not determined. The relationships can be added or modified using the HydroBase application (select the Setup | NWR Transmitter option). These definitions should match the county listening area codes defined in the CRS database.

4) Product Identifiers in the RiverPro Product Settings.

   The nine-character product identifier defined in the product settings is used in the header of the products sent to the CRS unit by RiverPro. This identifier, whether it be from an explicit identifier or from an identifier created via wildcard substitution, must match the identifier defined in the CRS unit.

5) Product Identifiers in the CRS Database.

   The CRS only accepts products with a certain nine-character identifier. Two different checks of the identifier must be satisfied to have a product broadcast for a give tower. First, the identifier in the product header must match the list of identifiers accepted by the CRS. Second, it must match the list of identifiers associated with the appropriate tower. Use the CRS interface to define these identifiers, making sure that they match the identifiers defined in the RiverPro product settings.

6) County-to-Tower Relationships in the CRS Database.

   The CRS only broadcasts products for a given tower if at least one listening area code specified in the product header matches an entry in a list of counties in the CRS for the given tower. Listening area codes can be specified in the CRS database as either a county or a zone. RiverPro only supports the county definitions of this information, so the zone codes in the CRS are of no consequence for RiverPro.

6.0 RiverPro Template Features

As discussed in previous sections, the product content is controlled to a large measure by a set of definitions referred to as the product settings. Contained within these instructions are the names of the templates to use for each of the product sections/subsection. The templates are at the core of the text generation functions as they ultimately determine the text that appears in the output product.

RiverPro is particular in regard to the format of the templates. The structure of the templates must follow the rules described in Appendix A. If RiverPro cannot resolve the structure or format of the template instructions, RiverPro issues an error message and continues processing the template and generating the product.

6.1 Template Features

There are different forms of the templates used for the different product section/subsections. All template forms support the basic feature of phrases that are inserted into the generated product. For most template forms, these phrases can include variables whose value is inserted within the phrase. A few template forms support the specification of a conditional expression associated with the phrase, where the phrase is inserted into the product only if the condition evaluates to True. The three different features of templates are detailed below.

- Phrase Insertion.

  All templates allow template phrases to be inserted verbatim into the product. For the basis section and the call-to-action section, only phrase insertion is supported; i.e. no variable substitution or conditional control is supported.

- Variable Substitution.

  Templates for all sections except the basis and call-to-action sections allow the values of RiverPro variables to be substituted in the phrase. Variable substitution usage can be demonstrated in the summary prologue section. If the phrase "The following rivers are included in this warning: <RiverList>" is specified in the template, then a list of rivers is substituted in place of the <RiverList> variable name in the phrase to form a full phrase.

- Conditional Control.

  For the templates used in the summary section, summary prologue section, and the data roundup section, phrases are inserted only under certain

circumstances. An example is in the data roundup subsection, where the template phrase "THE HEIGHT ABOVE FLOOD STAGE IS <FcstFSDeparture> FEET" is written only if the <MaxFcstStg> value is greater than the <FldStg> value. The conditional statement associated with the phrase may read: "(<MaxFcstStg> GT <FldStg>)".

6.2 Usage of Templates

The templates are processed in ways depending on the product section/subsection being created. Each of these methods is explained below.

- The same, single template is used for a section/subsection, although it may be used more than once.

  For the header, basis, summary prologue, and tabular sections, a single template is used once, and the resulting text is inserted into the product.

  These sections/subsections do not present information specific to a single forecast point or forecast group. Therefore, the single template is processed once only. For the tabular section, although it presents information for multiple locations, the template is used once only. This provides the easiest way to control the tabular section content; using a template for each forecast point would be too cumbersome.

  In the case of the impact and comparison subsections, which are repeated for each forecast point in the point-specific section, the same template is used repeatedly for each of the included forecast points.

- A unique template is used for each forecast point or group in a section/subsection.

  This method is used for the summary section and the data roundup subsection.

  When creating the summary section and the point specific section, which includes the data roundup subsection, text are generated by looping on each of the forecast groups or forecast points, respectively. Then, for each iteration through the loop, a template is processed for the forecast group or forecast point. A unique template may be used for each forecast group or forecast point. This allows the template to be customized for the particular characteristics of the forecast group or forecast point.

- Multiple templates are used for the section/subsection.

This method applies only to the call-to-action section. Each template contains a single call-to-action statement, thereby allowing specification of one or more call-to-action statements (i.e. templates) as desired.

The list below summarizes the different template forms and their usages for each product section/subsection. All templates provide for phrase insertion as the basic means for generating text, so that feature is not listed below.

1) Header section:
   Variable substitution.
   Single template only.

2) Basis section:
   Phrase insertion only.
   Single template only.

3a) Summary Prologue section:
   Variable substitution, Conditional control.
   Single template only.

3b) Summary section:
   Variable substitution, Conditional control.
   Unique template can be specified for each forecast group.

4) Tabular section:
   Variable substitution.
   Single template; the template includes all forecast points and locations.

5a) Data Roundup subsection:
   Variable substitution, Conditional control.
   Unique template can be specified for each forecast point.

5b) Impact Statement subsection:
   Variable substitution.
   Same template used for each forecast point.

5c) Historical Comparison subsection:
   Variable substitution.
   Same template used for each forecast point.

6) Call-to-Action section:
   Phrase insertion only.

Multiple templates supported.

One last note about the template processing. Templates for all sections except the tabular section process the template by reading the entire template into a temporary buffer. The buffered template information is then used to generate the product text. This imposes a limitation in that only one set of instruction in the FORMATS-VARLIST records are buffered. If the template uses these records more than once, the last one is preserved, and all preceding definitions for this information are lost. The result of this is that only one format can be specified for a given variable. In the tabular section, the template is not buffered, but is processed “on-the-fly”. Therefore, multiple FORMATS-VARLIST records can be specified and will be processed individually.

6.3 Template Variables

A fundamental concept of the template approach used in RiverPro is that variable names can be specified in the templates. Variables can appear in template phrases and conditional statements. They can also be used in variable lists that are used together with the template format specifiers, as described later. Remember that some sections/subsections only support phrase insertion in templates; i.e. they do not support variable substitution. If a variable name is given in one of these templates, the variable name itself is simply echoed verbatim in the output text.

All the variables available within the RiverPro application are listed in Tables 6-1 and described in detail in Section 6.4.1 and Appendix B.

Table 6-1. Quick Reference List of /RiverPro Template Variables

Variables independent of forecast groups/points:

<ProdId>
<ProdCateg>
<CurDate>
<IssuanceNumber>

<UGCListZ>
<UGCListC>

<GrpList>
<CountyList>
<RiverList>

<Day0>
<Day1>
<Day2>
<Day3>
<Day4>
<Day5>

Forecast group variables:

<GrpId>
<GrpIdName>

<GrpMaxCurCat>
<GrpMaxCurCatName>

<GrpMaxFcstCat>
<GrpMaxFcstCatName>

<GrpOMFCat>
<GrpOMFCatName>

<GrpObsFound>
<GrpFcstFound>

<NumGrps>
<GrpFPList>

Location E-19 variables

<Id>
<IdName>

<County>
<StateId>
<StateName>
<River>
<Reach>
<Proximity>
<FldStg>
<BankStg>
<WStg>

<MinCatVal>
<ModCatVal>
<MajCatVal>
<RecCatVal>

<ImpactStg>
<ImpactDescr>

<HistCrestDate>
<HistCrestStg>

Location observed data variables

<“PE value”>
<“PE time”>

(See Section 6.4):

Forecast point stage variables

<ObsStg>
<ObsCat>
<ObsCatName>
<ObsTime>

<MaxFcstStg>
<MaxFcstCat>
<MaxFcstCatName>
<MaxFcstTime>

<OMFVal>
<OMFCat>
<OMFCatName>

<ObsStgTrend>
<StgTrend>

<SpecObsStg>
<SpecObsStgTime>
<SpecFcstStg>
<SpecFcstStgTime>

<ObsCrestStg>
<ObsCrestTime>
<FcstCrestStg>
<FcstCrestTime>

<MaxObsStg24>
<MaxObsStg06>

<ObsRiseFSTime>
<ObsFallFSTime>
<FcstRiseFSTime>
<FcstFallFSTime>

<ObsFSDeparture>
<FcstFSDeparture>
<ObsFSDepartureA>
<FcstFSDepartureA>

<NumObsStg>
<NumFcstStg>

For certain variables, the type-source rank-stepping feature is supported. This feature is described in the Section 6.4.1 notes which discuss the type-source code feature for the physical element data variables. The type-source ranking feature instructs the program to use the highest-ranking source of data for a given location-physical element-type code; if a value is not available, then the next highest rank is used, etc.

Type-source rank-stepping is now supported for traditional template variables such as <ObsStg> and <MaxFcstStg>. The rank-stepping feature is also provided in observed stage variables, which are not physical element-type variables; however, this feature is not available for for forecast stage variables. The supported variables include the observed forecast-point stage variables and the observed forecast-group stage variables. Specifically, the observed forecast-group stage variables covered are those that begin with: <GrpMaxCurCat...>. The observed value used in determining the <GrpOMFCat...> is derived using rank-stepping, but not the forecast value. All the observed forecast-point stage variables listed in Table 6-1 of the RiverPro Reference Manual are included.

6.4 Physical Element Variables

RiverPro includes a powerful feature to include data for any location and any physical element available in the database. Either the value or the time of the value can be specified. The feature is currently limited to the tabular section of the product.

6.4.1 Format of Variables

The ability to load any location and any physical element requires the use of a rather unique and flexible format. It is not practical to have a RiverPro template variable for each physical element of interest. Therefore, a generic format has been defined for use in customizing the tabular template file to include the different data elements. This variable does not have a specific name like traditional RiverPro template variables. The format of the variables is as follows:

<[lid,] pe, dur, ts, extr, timespec [,showtime | , deriveins[,showtime]] >

where,

lid	= optional 3-8 character location identifier
pe	= 2-character SHEF physical element code
dur	= integer SHEF duration code
ts	= two-character SHEF type-source code
extr	= one-character SHEF extremum code
timespec	= time specifier

deriveins = optional derived data instructions
showtime = optional show time instead of value indicator

In the notation above, a bracket indicates an optional field. The vertical bar (|) indicates the logical OR operator - e.g. A|B means specify A or B. The definition consists of a collection of tokens, where each token is delimited by a comma. No blank spaces are permitted in the definition! Each token is detailed below.

Location Identifier/Physical Element:

The definition begins with either a location identifier or a physical element code as the first token. If the first token is between 3 and 8 characters, it is assumed to be a location identifier. If the first token is two-characters, it is assumed to be a SHEF physical element. In this case, the user can specify the location identifier through use of the template record type “ID:”.

When the first token is a location identifier, then the next token is expected to contain the two-character physical element code. As with all of these codes, this mandatory field is used to extract data from the IHFS database that matches the requested code.

Duration:

The token for the duration code follows next. This mandatory field is defined using the coded integer approach described above. For most data, this value is set to 0, which implies an instantaneous reading. Non-zero values are typically used only for precipitation data, which is always associated with a duration.

All the SHEF codes are described in the document “Standard Hydrometeorological Exchange Format Version 1.3, Weather Service Hydrology Handbook No.1", dated March 1998. This document describes the SHEF physical element codes in Table 1 and Appendix G, the SHEF type-source codes in Table 4, and the SHEF extremum codes in Table 5. The SHEF duration codes are coded in a special integer form discussed in Note 2 of Appendix H. RiverPro supports almost all the SHEF duration codes, whose coding scheme is repeated here for ease of reference:

0	-	instantaneous	0xxx - xxx minutes
1xxx	-	xxx hours	2xxx - xxx days
3xxx	-	xxx months	4xxx - xxx years
5004	-	time period beginning at 7AM local time prior to the observation and ending at the observation time	

Type-source:

The next token is the mandatory token for the two-character type-source code. All valid SHEF type-source codes are supported. These include observed (R*), processed (P*), forecast (F*), contingency data (C*). To request data with a specific type-source code, specify both characters.

Alternatively, RiverPro supports a feature referred to as type-source rank-stepping, which is requested by giving the second letter as an asterisk. Using this feature results in RiverPro checking for a value that matches the highest ranked type-source code for the given location-physical element-duration-extremum combination. If that value is not find, then it checks for a value for the next highest ranked type-source code, and so on. This feature allows the program to retrieve the “best” value for a given location which may have more than one source of data.

The rank-stepping is supported for observed, forecast, and processed data types, although no rank-stepping support is provided for any precipitation data requests

Extremum:

After that, the token with the one-character extremum code is expected. The extremum code for most data is the default character designated by the letter “Z”

Time Specifier:

Next comes the time specifier token. This can be given in very different ways.

First, the keyword “LATEST” can be specified, to tell RiverPro to get the latest observed value matching the location, physical element, duration, type-source, and extremum.
The LATEST directive is supported for data with a type-source code representing observed, processed, or contingency data; but not forecast data.

In the other direction on the time scale, the keyword “NEXT” can be used, to get the next matching forecast value. This gives the value closest in time to the now. Using the ‘LATEST” terminology for this instruction would be confusing, so the keyword “NEXT” was adopted.

Alternatively, the time specifier can be specified in the following manner:

reference_day|hour:minute|hour_window

where,

reference day = The day given as an integer value relative to the current day. A value of 0 implies today, a value of -1 implies

yesterday, etc. The value can be specified to -60 days (in the past).

hour:minute = The hour and minute for which data will be retrieved. These integer values are separated by a colon. The hour must be between 0 and 23, while the minute must be between 0 and 59. This hour:minute value gives the absolute GMT time for the day implied by the reference day given in the first field.

hour_window = The hour window around the absolute time implied by the combination of the reference day and the hour:minute specified in the first two fields. RiverPro will try to find a value matching the time exactly. If such a value is not available, then RiverPro will use the value closest in time to the specified time, but which is still within the time window. A value of 2 implies a 4 hour window, with +/- 2 hours on each side of the specified time. This value must be between 0 and 48 hours.

Derivation Instructions:

After the time specifier, up to two types of additional tokens can be specified. The first one is the “deriveins” token, which allows for various instructions for deriving a data value from values in the database. The derived instructions support the following forms:

CHG##	MIN##	MAX##
ACC		
GZ	STG	FLOW

The CHG##, MIN##, and MAX## instructions direct RiverPro to find the change in value, whether it be positive or negative, or the minimum or maximum value or the defined time period. The ## is a count of the number of hours to consider, ranging from 0 to 720. It defines a time period ending at the time implied by the time specifier discussed above and for a duration given as the ## value. The CHG directive is not supported for forecast nor contingency data.

The ACC instruction applies for requests for data with a physical element of “PP”. By default, when PP data are requested, RiverPro will NOT attempt to accumulate successive time periods to assemble a longer duration value. For example, if a 24 hour PP value is requested, but only 6 hour PP values are available, the default behavior is to NOT accumulate the 6 hour values to 24 hours. If the ACC instruction is given, then RiverPro will accumulate PP values as deemed necessary to fill the requested time period.

The GZ instruction reads the gage zero (GZ) value for the requested, presumably river, station and subtracts the value from the reported stage value to give a relative stage.

The STG and FLOW instructions operate in a complimentary fashion; they convert the flow and stage values to stage and flow, provided a rating table exists for the station.

In some cases, it is reasonable to combine derived instructions, such as MIN and FLOW. Therefore, the previous limitation of allowing only one derived instruction to be specified has been dropped, with plenty of exceptions. Note that the neither of the GZ, STAGE, and FLOW instructions can be used in combination with the other two. Furthermore, Riverpro rejects illogical combinations of derived instructions. Also note that no derived instructions can be specified for contingency data (SHEF type-source = 'C*').

Show time flag:

The “showtime” token indicates that RiverPro should retrieve the time of the value, rather than the value itself. The “showtime” token consists of the keyword “TIME”.

Both the derived instructions and show time tokens are optional, so it is possible that zero, one, or two tokens follow the time specifier. Both can be specified, but in this case, the derived instructions token must be given first. Examples of the different combinations of the these two tokens are given below.

...timespec,CHG24> -	Show the 24-hour change value.
...timespec,MIN24> -	Show the minimum value for 24-hour period.
...timespec,MAX24,TIME> -	Show the time of the maximum value for the 24-hour period.
...timespec,TIME> -	Show the time of the requested value.

6.4.2 Retrieval of Data

The previous section described the syntax for specifying observed data for inclusion into the tabular section of RiverPro. While doing so, the section also discussed some of the effects of the various tokens and fields that make up the full variable specification. This section elaborates on the effects of the variable specification and provides discussion of some special cases that can arise.

General comments:

The observed data variables are given in the tabular template VARIABLE records. In

most senses, they are just like any variable. For example, the format associated with these variables and specified in the FORMATS template record must agree with their expected returned value. Therefore, if the “showtime” token is specified, then the format must be a time format. Otherwise, a number is retrieved, so the format must be a floating point format.

When retrieving data, note that the various SHEF-based attributes that are requested must be carefully considered. What is specified in the variable definition is exactly what the program will try to match in the database. Specifically, the physical element, duration, type-source, and extremum must match.

Using the location id in the variable specification:

Remember that the triggering of text for phrase variables in the tabular section is triggered by the FP_ID and MISCWRT records.

The FP_ID record triggers output for the forecast point given in the FP_ID record, using the variables and formats defined in the VARLIST and FORMATS template records. If the observed data variable contains a location identifier, then it is used - the FP_ID identifier is ignored. The FP_ID identifier is used only if the observed data variable does not specify a location identifier.

The MISCWRT outputs data for variables that are independent of a forecast point, using the FORMATS-VARIABLE record definitions in effect. If the MISCWRT record is used to retrieve observed data, then an lid must be specified. Otherwise, RiverPro cannot determine which location is should consider.

For both the FP_ID and MISCWRT variable, one can have different location identifiers specified in different variables of the VARLIST record. This will result in the generated tabular output having more than one location’s data on the same line of the product. By specifying the station identifier and name information as string constants in the FORMATS specification, and specifying the corresponding identifiers in the observed data variables of the VARLIST specification, a product can have two or more station’s data given with the supporting information, on the same line of the tabular text.

Retrieval of precipitation data:

For precipitation data, one must choose between using PP (incremental) data and PC (cumulative) data to extract the data. For PC data retrievals, RiverPro performs the necessary computations to obtain the incremental accumulation over the requested time period. The hour time window is not used for PC data requests. If the LATEST time specifier is used for PC data, it uses the top of the current hour as the ending time, and tries to determine the incremental precipitation for the period. A certain percentage of the time period must be “filled” in order to return a valid value. For

example, if requesting a 24 hour value, then 60% (current threshold) of the 24 hours must have returned data, or about 14 ½ hours.

For PP data retrievals, RiverPro has the capability to add the shorter-duration individual PP data value to get a summed value over the requested duration. The program uses the tokens in a rather unique way when retrieving requested PP data. If the LATEST time specifier is given, then the hour time window is used to look for the requested duration ending within the specified time period. If an explicit ending time is given, then the hour time window is applied to the beginning time (knowing the duration) and ending time to look for PP data in a larger time window. If not in "auto-ACCume" mode, then the best match for the requested data is returned, if any exist. If in "auto-ACCume" mode, then the data are added as needed to build an accumulated value.

Time specifiers:

If using the LATEST time specifier, then only data within a certain number of hours of the current time is considered. This prevents very old data be very used to represent the "latest" conditions. The number of hours value used for this purpose is defined in the IHFS database as discussed in Appendix D. This screening out of old "latest" data only occurs when requesting data that is not derived.

When using the LATEST specifier in conjunction with the derive instruction for XX hour change, RiverPro first finds the latest value, then tries to determined the previous value based on the time of the latest value. For example if requesting the latest 24 hour change, then the latest value is found, then it searches for a value around 24 hours previous in order to compute the change in value.

The NEXT and LATEST directives are based on the current time if combined with the derived instructions MIN or MAX. Only the forecast data that is for the latest basis time that has data within the time range requested is retrieved. If one wishes to retrieve forecast data from the non-latest basis time series, a possible work around is to specify a data time window that includes only that non-latest time series. The LATEST directive implies a time window straddling the current time when used for contingency data.

6.4.3 Code Translation Feature

Under certain conditions, RiverPro translates numeric data into character strings for representation of the physical element variables. First, RiverPro translates trace precipitation amounts to "T" in formatted products for data types: PC, PP, SD, SF, SI, and SW.

Second, a new feature was added to the tabular template implementation for displaying observed data variables with a SHEF physical element code that uses an encoded numeric value to represent a descriptive attribute of a meteorological condition, such as “blowing snow”.

This features was implemented in a simplified form prior to Build 5.0. More functionality was added for the translation feature in Build 5.0. Prior to Build 5.0, the translation was performed only for SHEF physical element values for XW (present weather), using the following text file:

/awips/hydroapps/whfs/local/data/app/riverpro/xw_translate.dat

This file must be created by each office as desired, and contains records that give two fields on each line. The first field is the numeric value of the present weather code and the second field is the text phrase to be associated with the value. A single blank must separate these two fields; the phrase field itself can contain embedded blanks. A few sample lines for this file might be:

21 Rain
41 Fog
60 Raining
86 Heavy snow

In Build 5.0, this file was implemented as a database table (ShefPETrans). Furthermore, the feature was extended to almost all data values in the database that are in coded form (e.g., present weather, past weather, etc.), For example, if the user asks for XP data (i.e., past weather) and retrieves coded value 7 from the database, RiverPro translates that coded value to the English phrase "snow or rain and snow mixed". This translation occurs for the following SHEF physical elements:

-- AF (surface frost intensity)
-- AM (surface dew intensity)
-- GR (ground frost structure)
-- GS (ground state)
-- HI (stage trend)
-- NC (river control)
-- PE (pressure characteristic)
-- PT (precipitation type)
-- XP (past weather)
-- XW (present weather)

The phrases specified can be customized locally. The phrases should not be too long as the product line in which they are given must fit within the 69 character limit of the tabular section. Refer to Appendix C of the SHEF Manual for guidance on the value of

the present weather codes.

When the tabular template specifies the code in the physical-element type variables, RiverPro attempts to find a code match. If one exists, then the text phrase is inserted into the product, using the entire text phrase given, regardless of the actual format specified for the variable in the FORMATS line in the template. If a match does not exist, then the data is treated as a numeric, and the format specified is used for presenting the code.

6.5 Missing Data Operations

This section describes how RiverPro handles missing data in computing the recommended forecast points to include and in the processing of templates.

In the algorithm that determines the forecast points to include, if no stage data, either observed or forecast, is available for a given forecast point, then the algorithm recommends the forecast point NOT be included in the product.

How RiverPro deals with missing template data varies depending upon whether the data is missing from a variable given in a conditional expression or is missing from a template phrase. If any data are missing for a variable in a conditional expression, then the particular sub-expression containing the variable with missing data evaluates to FALSE unless the expression contains the MISSING value indicator; e.g. (<ObsStg> NE MISSING).

Because a full conditional expression may contain multiple sub-expressions, it is possible that the full expression evaluates to True even if the MISSING value indicator is not used. For example, this can occur if the full expression contains two sub-expressions, one that evaluates to False because of missing data and other sub-expression which evaluates to True. If the logical operator OR is used - as in: False OR True - then the expression would evaluate to True.

If data are missing from a phrase, then a label indicating missing data is inserted into the phrase. The missing data indicator is a string that can be specified by the user. Specifically, the user can specify a string that is up to 12 characters. A unique indicator string can be specified for missing numeric data, missing stage category names, and missing times. If data are missing from a field that is neither a stage category name, a time value, or an integer or numeric value, then the field is simply not shown in the product phrase; i.e. no missing indicator is shown. An example of this is the river name for a forecast point.

For the tabular section, it is imperative that the data columns are properly aligned even if data are missing. Therefore, RiverPro truncates the missing label or pads it with

blanks so that the length of the label matches that given with the format specifier for the variable.